AD-A175 786 GROWTH OF HGZNTE LAYERS BY LPE TECHNIQUE(U) ISRAEL ATOMIC ENERGY COMMISSION YAVNE SOREQ NUCLEAR RESEARCH CENTRE A SHER 01 JUL 86 DAJA45-85-C-0049 1/1

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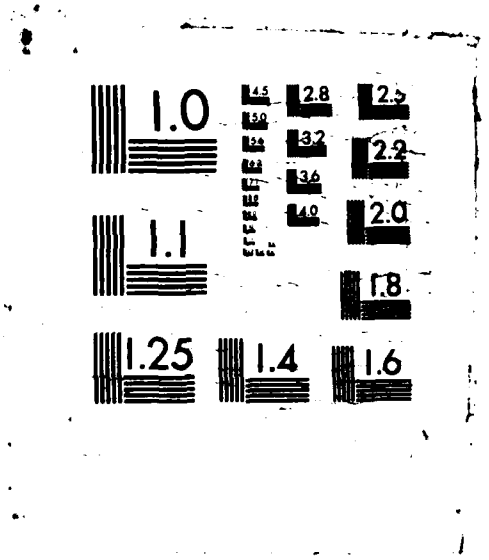
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Growth of HgZnTe Layers by LPE Technique

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The objective of this project is to develop liquid phase epitaxial layers of Hgl-xZnxTe and to study their possible applicability as a material for IR detectors. The program for the first year includes two tasks:

1. Optimization of the growth process of the HgZnTe epilayers.
2. Growth of high Zn content Cdl-yZnyTe crystals, $0.15 \leq y \leq 0.22$, (by Bridgman method) for substrates which are lattice matched with the epilayers.

In the present interim report experimental details and results concerning the two tasks are described.

Task 1

The main effort was to control the thickness of the epilayers and its uniformity over the substrate. Controlling the thickness is essential for device application and, in addition, provides an insight into the growth parameters.

Hgl-xZxTe epilayers, x Between 0.15 to 0.25, were grown by LPE in horizontal, open tube, slider boat system (1). Solutions of Hg in Te were equillibrated with excess polycrystalline ZnTe for approximately two hours. Temperature of equillibration was about 470°C. Most of the growth runs were performed on CdTe and $Cd_{0.96}Zn_{0.04}Te$. Lattice mismatch between the epilayers and substrates was of the order 10^{-2}. Some of the growth runs were performed on high Zn content substrates, $y \sim 0.20$, in which lattice mismatch was not more than 10^{-3}.

In an horizontal slider boat system the thickness of the epilayer is determined primarily by the thermal cycle of the growth

process. Assuming diffusion limited growth (2) the thickness, d, is given by:

$$d=c\ (\Delta\ t^{1/2} + 2/3\ Rt^{3/2})$$

where C is the material constant, Δ is the degrees supercooling, R is the cooling rate during growth and t is the growth time.

During our experiments the values for R and Δ were between 0 to $0.16\ \mu m/°c\text{-}min^{1/2}$ and 4°C to 6°C, respectively.

The thickness of the epilayers was obtained by two methods; direct inspection on cleaved (110) cross section and from the interference pattern of the IR transmission.

The main results are:

1. Depending on growth conditions the thickness of the epilayers was varied from 5 to 12μm.
2. The uniformity of thickness over an epilayer was better than 1μm.
3. Under identical growth conditions the reproducibility of thickness between run to run was about 1μm.
4. The constant C in expression (1) was found to be $0.15\pm0\text{-}0.3\ \mu m/°C - min^{1/2}$.
5. The value of C was practically independent on lattice mismatch.

Conclusions

Using our LPE growth process the controlling of the thickness of the epilayers was fairly good.

The minor changes in C and its independence on lattice matching indicate that the epilayer growth is diffusion limited, as was

assumed. The absolute value of C is still in question.

Task B

In the last interim report the procedure of growing $Cd_{0.8}Zn_{0.2}Te$ single crystals was described. The major problem of this procedure was the formation of radial cracks in the boule.

Using the same procoduse, now, with lower Zn concentration boule without any cracks were obtained. The nominal composition of the starting materials was $Cd_{0.84}Zn_{0.16}Te$.

The distribution of Zn along the boules is plotted in fig (1). Twenty five wafers (111) oriented were cut from one of the boules. The (111) direction of the main grain was 5° off the growth axis of the boule. The single area of each wafer was more than 2.5 cm2. About 15 of the wafers were lattice matched with Hg1-xZn-Te epilayers, $0.15 \lesssim x \lesssim 0.22$.

The main characteristics of CdZnTe wafers are:

1. Etch pits density, as revealed by Eg^{-2} solution, was not homogenious. In the worst areas e.p.d. was about $5x10^4/cm2$.
2. The wafers were transparent in the spectral range 2 - 25 μm.
3. No precipitates were detected using IR microscope.
4. Half width double crystal rocking curves spectra which were taken in different areas of the wafers changed between 64" to 100".

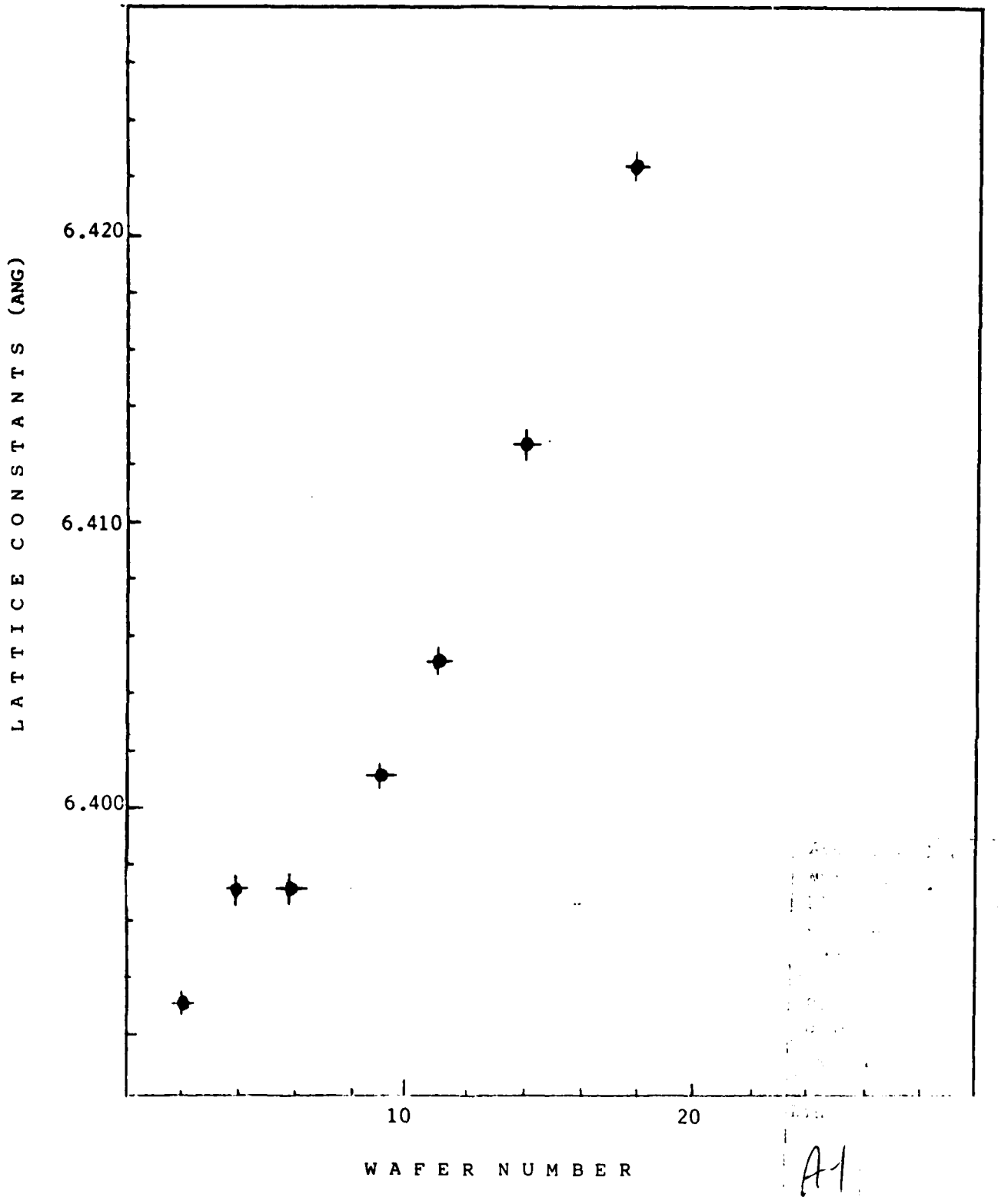

Fig 1: Distribution of Zn along a boule as detected by lattice constant measurements.

Conclusions

It seems that improved CdZnTe crystal can be obtained by reducing the Zn concentration in the starting materials. About 60% of the substrates were with lattice constants suitable to liquid phase epitoxy of Hgl-xZnxTe, $0.15 \lesssim x \lesssim 0.22$.

The characteristics of the substrates were comparable with those of CdTe.

The amount of the unused fund remained on the lst June 1986 is $20,850.

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